

REMARKS/ARGUMENTS***35 USC 112 Rejections***

In sections 1 and 2 of the Office Action, the Examiner rejected Claims 10, 12, 14, 19 and 22 under 35 USC 112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Specifically, the Examiner stated that “it is not clear how the controller monitors the transmit and receive strengths of each laser portion and the RF portion. [The] specification describes (page 4, lines 7-10) each transmission channel has a transmit and receive strength, wherein the controller is configured to monitor the transmit and receive strength of each channel. [The] specification further describes (page 12, lines 10-12) receiving external weather forecasts and monitoring power reduction based on feedback from another hybrid wireless link 100. It is not clear how the controller is configured to monitor transmit and receive strengths of the laser portion and the RF portion.” The Applicants respectfully submit that the specification does make it clear how, in one embodiment, a controller may monitor the transmit and receive strengths of the laser portion and the RF portion.

The specification, on page 12 starting at line 18, indicates how, in one embodiment, the transmit and receive strengths of the signals may be monitored. The specification states, “continually monitoring the transfer rate of, errors in, and transmission power received by, each of the laser portion 104 and the radio frequency portion 106.” The Applicants submit that one skilled in the art will know that there are many ways to monitor the transfer rate, the errors, and the received transmission power. Further, the Applicants submit that a specific example of one method that may be employed is described on page 19 starting at line 14. Specifically, the specification states, “The electrical signal 334 and a reference signal 336 obtained from weather conditions, measured power, or a look up table are provided to a logical AND gate 338 for comparison.” Thus, the Applicants respectfully submit that it is clear how the controller monitors the transmit and receive powers of each laser portion and the RF portion. Therefore, the Applicants respectfully request that this rejection be withdrawn.

On page 3, in the second section of the Office Action, the Examiner stated that “Claim 19 recites the limitation “the controller of each node” in line 2. There is insufficient antecedent basis for this limitation in the claim.” The Applicants respectfully disagree.

5 Claim 19 is a dependent claim based on claim 18. Claim 18 claims, in part, “a plurality of nodes, each node including: ... a controller.” Thus the Applicants submit that there is antecedent basis in Claim 18 for the limitation of “the controller of each node” as recited in Claim 19. Therefore, the Applicants respectfully request that this rejection be withdrawn.

10
35 USC 102 Rejections

Rejections based on WO 00/08783 as a Reference

In sections 3 and 4 of the Office Action, the Examiner rejected Claims 1, 2, 5, and 8 under 35 USC 102(b) as being anticipated by WO 00/08783 to Watson, herein referred
15 to as the Watson publication. Specifically, regarding Claim 1, the Examiner stated that Watson teaches a node (46, fig. 5) incorporating hybrid radio frequency and optical wireless communication links (page 5, lines 16-18), the node comprising: at least one laser portion for transmitting data (18, 20, fig. 5); at least one radio frequency portion for transmitting data (28, 30, fig. 5); a data receiver (14, 54, fig. 5) for receiving data from a
20 data source (36, fig. 5); and a controller (14, fig. 5) configured to receive data from a data source and connected with the laser portion (18, fig. 5) and the radio frequency portion (28, fig. 5) to allocate portions of the data to be transmitted through the laser portion and the radio frequency portion (page 9, lines 15-23, page 10, lines 1-6). The Applicants respectfully disagree with the characterization of the Watson publication by the
25 Examiner.

In order to establish a prima facie case of anticipation, the Examiner must set forth an argument that provides (1) a single reference (2) that teaches or enables (3) each of the claimed elements (as arranged in the claim) (4) either expressly or inherently and (5) as interpreted by one of ordinary skill in the art. All of these factors must be present,
30 or a case of anticipation is not met. Thus, “[a]nticipation requires the disclosure in a

single prior art reference of each element of the claim under consideration.” *W.L. Gore & Associates v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983).

The Examiner stated that reference numerals 18 and 20 of Fig. 5 of the Watson publication teach the laser portion of the present application. The Applicants disagree with the Examiner’s conclusion.

Page 9, line 21, of the Watson publication, labels reference numeral 18 as an IR transmitter. Page 9, lines 17-18, of the Watson publication, label reference numeral 20 as an IR receiver. Page 7, lines 11-12, of the Watson publication, teaches that the IR transmitter 18 is of the conventional design for transmitting IR signals 20 to external devices. Page 2, lines 4-7, teaches that the Watson publication is concerned with connecting portable devices such as Personal Digital Assistants, handheld computers, and cellular phones. One skilled in the art would understand that these are all short range (within a few meters) applications and typically infrared light emitting diodes or the like are used. Further, while the Watson publication is vague as to the type of transmitter being used, the Watson publication, on page 7, lines 6-9, states “It should be pointed out that the conventional optical photodiodes used for IR receivers 22 utilize the same core high frequency bipolar silicon (HF-Si) or silicon-germanium (SiGe) technologies that are utilized in the manufacture of RF receivers 32. The Applicants submit that nowhere in the Watson publication is the term “laser” mentioned. Further, the Applicants point out that the application taught in the Watson publication would not direct one skilled in the art to utilize lasers due to the unnecessary expenditure of more power than necessary to accomplish the task (given the short ranges that are described), the directionality of lasers and the inherent dangers. Thus, the Applicants submit that the Watson publication does not teach, disclose or suggest a laser portion as is claimed in Claim 1.

Claims 2 through 17 are based on Claim 1. For the reasons given above, the Applicants submit Claim 1 is patentable over the Watson publication. Therefore, the Applicants submit that claims 2-17 are also patentable over the Watson publication at least through their dependency on an allowable base claim.

Rejections based on US Patent No. 5,585,953 as a Reference

In section 5 of the Office Action, the Examiner rejected Claims 1, 2, 5, 6 and 8 under 35 USC 102(b) to Zavrel (US Patent No. 5,585,953), herein referred to as the Zarvel reference. Specifically, the Examiner stated that the Zavrel reference teaches a node (10, fig. 1) incorporating hybrid radio frequency and optical wireless communication links (col. 1, lines 50-55), the node comprising: at least one laser portion for transmitting data (24, fig.1); at least one radio frequency portion for transmitting data (12, fig.1); a data receiver (14, 26, fig.1) for receiving data from a data source (col. 1, lines 65-67, col. 2, lines 5-8); and a controller (16, fig. 1) configured to receive data from a data source (col. 1, lines 64-65) and connected with the laser portion (24, fig.1) and the radio frequency portion (12, fig.1) to allocate portions of the data to be transmitted through the laser portion and the radio frequency portion (col. 2, lines 1-10). The Applicants respectfully disagree with the characterization of the Zavrel reference by the Examiner.

In order to establish a prima facie case of anticipation, the Examiner must set forth an argument that provides (1) a single reference (2) that teaches or enables (3) each of the claimed elements (as arranged in the claim) (4) either expressly or inherently and (5) as interpreted by one of ordinary skill in the art. All of these factors must be present, or a case of anticipation is not met. Thus, “[a]nticipation requires the disclosure in a single prior art reference of each element of the claim under consideration.” *W.L. Gore & Associates v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983).

The Examiner stated that reference numeral 24 of Fig. 1 of the Zavrel reference teaches the laser portion of the present application. The Applicants disagree with the Examiner’s conclusion.

Col. 1, line 54 of the Zavrel reference indicates that reference numeral 24 is an infra-red (IR) transmitter. The example that the Zaverl reference gives for the IR transmitter is a photo-emitting diode, see col. 2, lines 13-14. The Applicants are unaware where in the Zavrel reference the word or concept of a “laser” is taught, disclosed or suggested. Thus, the Applicants submit that the Watson publication does not teach, disclose or suggest a laser portion as is claimed in Claim 1.

Claims 2 through 17 are based on Claim 1. For the reasons given above, the Applicants submit Claim 1 is patentable over the Zavrel reference. Therefore, the Applicants submit that claims 2-17 are also patentable over the Zavrel reference at least through their dependency on an allowable base claim.

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Rejections based on US Patent Publication No.2002/0097468 as a Reference

In section 6 of the Office Action, the Examiner rejected Claims 1-10 and 15-16 under 35 USC 102(e) as being anticipated by Mercherle et al. (US Patent Publication No. 2002/0097468), herein referred to as the Mercherle publication.

10 “A rejection based on 35 U.S.C. 102(e) can be overcome by: ... (D) Filing an affidavit or declaration under 37 CFR 1.131 showing prior invention, if the reference is not US Patent (or US patent application publication) claiming the same patentable invention.” MPEP §706.02(b)

15 The Applicants respectfully note that the claims of the Mercherle publication are directed toward an optical wireless transceiver for communicating broadband signals through freespace including a splitter and a plurality of lasers in transmitter modules, while the present application’s claims are directed toward splitting the data transmission between RF and laser portions depending on the reliability of each of the links.

20 The Applicants respectfully note that the effective date of U.S. Patent Application Publication No. 2002/0094768 is January 24, 2001. Applicants have submitted, herewith, two Declarations under 35 CFR 1.131 by the Applicants. The Declarations, along with their accompanying appendices demonstrate that this invention was conceived at least as early as August 21, 2000, and that diligent steps were taken inside the United States of America until the present application was filed on March 5, 2001. In addition, an
25 Invention Disclosure date-stamped and witnessed on August 21, 2000, is presented.

30 The Declarations under 37 CFR 1.131, along with the other evidence submitted herewith are sufficient to “swear behind” the effective date of Mercherle publication. The Applicants wish to note that the Mercherle is a common thread among the rejections under 35 U.S.C. 102(e) of Claims 1-10 and 15-16 in addition to the rejections under 35 U.S.C. 103(a) of Claims 11-14 and 17. Thus, by antedating the Mercherle reference, the Applicants have satisfied the Examiner’s concerns regarding these pending art-based

rejections under both 102(e) and 103(a). Should the Examiner need any further information or evidence, the Applicants encourage the Examiner to contact the Applicants at the Examiner's earliest convenience.

In view of the effective date established by the Declarations under 37 CFR 1.131 that is included herewith, the remaining effective prior art of record, taken individually, or in the aggregate, does not appear to contemplate all the limitations of any claim of the present invention.

Rejections based on Gerald article as a Reference

In section 7 of the Office Action, the Examiner rejected Claims 18-27 under USC 102(b) as being anticipated by Clark G., Willebrand H., and Achour M. "Hybrid Free Space Optical/Microwave Communication Networks: A Unique Solution for Ultra High-Speed Local Loop Connectivity," Proceedings of the SPIE – The ISOE, OWC III, vol. 4214, 6-7 November 2000, pps. 46-54, XP-001149555, Boston, MA, USA), herein referred to as the Gerald article. Applicants submit this rejection should have been posed as a rejection under 102(e), as a rejection under 102(b) requires the publication to be published one year prior to the filing date of the present application.

"A rejection based on 35 U.S.C. 102(e) can be overcome by: ... (D) Filing an affidavit or declaration under 37 CFR 1.131 showing prior invention, if the reference is not US Patent (or US patent application publication) claiming the same patentable invention." MPEP §706.02(b)

The Applicants respectfully note that the effective date of the Gerald article is November 6, 2000. Applicants have submitted, herewith, two Declarations under 37 CFR 1.131 by the Applicants. The Declarations, along with their accompanying appendices demonstrate that this invention was conceived at least as early as August 21, 2000, and that diligent steps were taken inside the United States of America until the present application was filed on March 5, 2001. In addition, an Invention Disclosure date-stamped and witnessed on August 21, 2000, is presented.

The Declarations under 37 CFR 1.131, along with the other evidence submitted herewith are sufficient to "swear behind" the effective date of Gerald article. Thus, by antedating the Gerald article, the Applicants have satisfied the Examiner's concerns

regarding these pending art-based rejections under both 102(e). Should the Examiner need any further information or evidence, the Applicants encourage the Examiner to contact the Applicants at the Examiner's earliest convenience.

5 In view of the effective date established by the Declarations under 37 CFR 1.131 that is included herewith, the remaining effective prior art of record, taken individually, or in the aggregate, does not appear to contemplate all the limitations of any claim of the present invention.

For at least the foregoing reasons the Applicants respectfully request that the existing claim rejections under 35 U.S.C. §102(e) and 103(a) be withdrawn.

Concluding Remarks:

In view of the foregoing, it is respectfully submitted that all now pending claims 1-28 are in allowable condition. Reconsideration is respectfully requested. Accordingly, early allowance and issuance of this application is respectfully requested. Should the Examiner have any questions regarding this response or need any additional information, please contact the undersigned at (310) 589-8158.

The Commissioner is authorized to charge any additional fees which may be required or credit overpayment to deposit account no. 50-2691. In particular, if this response is not timely filed, the Commissioner is authorized to treat this response as including a petition to extend the time period pursuant to 37 CFR 1.136(a) requesting an extension of time of the number of months necessary to make this response timely filed and the petition fee due in connection therewith may be charged to deposit account no. 50-2691.

Respectfully submitted,

Date

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Appendix 1

Declaration Under 37 CFR 1.131
Invention Disclosure

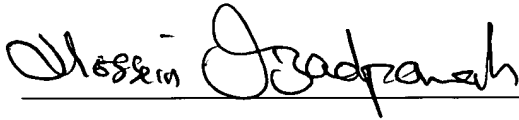
DECLARATION UNDER 37 CFR 1.131

We, Hossein Izadpanah, of 1659 Springhaven Ave., Newbury Park, California 91320, and Greg Tangonan of *Ateneo de Manila University, Katipunan Road, Loyola Heights, Quezon City, Metro Manila 1108, Philippines*, do hereby declare that we invented the subject matter of Patent Application No. 09/800,917 at least as early as the date of January 25, 2000, and by acts undertaken wholly in the United States of America, have diligently pursued this invention with the purpose of its reduction to practice. However, the purpose of this Declaration is to show that this invention was conceived prior to the priority date of January 24, 2001, of Patent Application Publication No. 2002/0097468 to Mercherle et al. and priority date of November 6, 2000, of Clark G., Willebrand H., and Achour M. "Hybrid Free Space Optical/Microwave Communication Networks: A Unique Solution for Ultra High-Speed Local Loop Connectivity," Proceedings of the SPIE – The ISOE, OWC III, vol. 4214, 6-7 November 2000, pps: 46-54, XP-001149555, Boston, MA, USA, and that its conception was coupled with diligent effort toward reduction to practice until reduction to practice occurred or until the filing date of March 5, 2001.

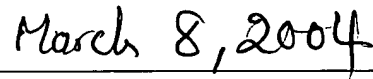
The invention that is the subject of this patent application was captured in the Invention Disclosure, included herewith as Appendix A and date-stamped on August 21, 2000. As noted on sheet 1 of the Invention Disclosure, we declare that we completed the first embodiment of the invention on January 25, 2000, with the initial conception of the invention captured in drawings in a notebook on January 19, 1999. The invention disclosure provides support for the subject matter in all of the claims of Patent Application No. 09/800,917.

We hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that

these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.



Hossein Izadpanah



Date

Greg Tangonan

Date

DECLARATION UNDER 37 CFR 1.131

We, Hossein Izadpanah, of 1659 Springhaven Ave., Newbury Park, California 91320, and Greg Tangonan of *Ateneo de Manila University, Katipunan Road, Loyola Heights, Quezon City, Metro Manila 1108, Philippines*, do hereby declare that we invented the subject matter of Patent Application No. 09/800,917 at least as early as the date of January 25, 2000, and by acts undertaken wholly in the United States of America, have diligently pursued this invention with the purpose of its reduction to practice. However, the purpose of this Declaration is to show that this invention was conceived prior to the priority date of January 24, 2001, of Patent Application Publication No. 2002/0097468 to Mercherle et al. and priority date of November 6, 2000, of Clark G., Willebrand H., and Achour M. "Hybrid Free Space Optical/Microwave Communication Networks: A Unique Solution for Ultra High-Speed Local Loop Connectivity," Proceedings of the SPIE – The ISOE, OWC III, vol. 4214, 6-7 November 2000, pps. 46-54, XP-001149555, Boston, MA, USA, and that its conception was coupled with diligent effort toward reduction to practice until reduction to practice occurred or until the filing date of March 5, 2001.

The invention that is the subject of this patent application was captured in the Invention Disclosure, included herewith as Appendix A and date-stamped on August 21, 2000. As noted on sheet 1 of the Invention Disclosure, we declare that we completed the first embodiment of the invention on January 25, 2000, with the initial conception of the invention captured in drawings in a notebook on January 19, 1999. The invention disclosure provides support for the subject matter in all of the claims of Patent Application No. 09/800,917.

We hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that

these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Hossein Izadpanah

Date

Gregory L Tang

Greg Tangonan

March 24, 2004

Date

SEND COMPLETED DISCLOSURE DIRECT

INVENTION DISCLOSURE

CORPORATE PATENTS AND LICENSING

Loc. CO, Bldg. C01, M/S A126

THIS INVENTION DISCLOSURE IS MADE
PURSUANT TO MY / OUR INVENTION AGREEMENT
WITH HUGHES AIRCRAFT COMPANY.



LABORATORIES

SHEET 1 OF

1. TITLE OF INVENTION

Hybrid RF and Optical Wireless Communication Link Technology and Network Architecture

2. INVENTOR(S)

NAME	PAYROLL NO.	SOURCE CODE	LOC	BLDG	MS	PHONE	MANAGER
Hossein Izadpanah	J3272	30-50-30	MA	250	RL65	317-5563	Bob Loo
Greg Tangonan	82675	30-50-00	MA	250	RL65	317-5208	A. N. Chester

This is to acknowledge that the above Invention Disclosure has been received by Corporate Patents and Licensing. The disclosure will be reviewed at the next Evaluation Committee Meeting of your organization and you will be promptly informed of the results. If you have any questions please contact the patent attorney listed on the bottom of this form.

This sheet will be returned to the inventor(s) as a confirmation of receipt by Corporate Patents and Licensing.

LOSS OF RIGHTS THROUGH RELEASE TO THE PUBLIC

The right to apply for and obtain a valid patent may be lost as the result of certain activities, such as (1) disclosing the invention outside of the company without an appropriate confidentiality agreement with the receiving party; (2) using the invention publicly; (3) using the invention privately to build or test items that are to be sold publicly; or (4) putting the invention "on sale" by selling or offering for sale an item or product that embodies or uses the invention, or is made or tested by use of the invention. Submitting a proposal with the intent to use the invention in the performance of a resulting contract puts the invention "on sale".

Please inform me immediately of any of these activities or any plans to undertake any of them.

ASSIGNED ATTORNEY: _____

PHONE () _____

PATENT DOCKET NO.

HRL
LABORATORIES

AUG 21 2000

PD# 006805

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WITH HUGHES AIRCRAFT COMPANY.



SHEET 2 OF

1. TITLE OF INVENTION

Hybrid RF and Optical Wireless Communication Link Technology and Network Architecture

2. INVENTOR(S)

NAME	PAYROLL NO.	SOURCE CODE	LOC	BLDG	MS	PHONE	MANAGER
Hossein Izadpanah	J3272	30-50-30	MA	250	RL65	317-5563	Bob Loo
Greg Tangonan	82675	30-50-00	MA	250	RL65	317-5208	A. N. Chester

3. PROOF ON CONCEPTION

A. BY WHOM WAS FIRST DESCRIPTION WRITTEN OR DRAWING MADE? Hossein Izadpanah	DATE 1/19/1999	TIME SPENT 1.0 Hour	ACCT. CHARGED CD195F9PL	LOCATION OF FIRST DESCRIPTION / DRAWING HRL Lab Notebook, Pp. 41(1999) & 56 (1/25/2000)
B. TO WHOM WAS INVENTION FIRST DISCLOSED? Bob Loo	DATE 1/19/99			

4. REDUCTION TO PRACTICE

A. WAS A DEVICE EMBODYING THE INVENTION CONSTRUCTED AND TESTED OR THE PROCESS PRACTICED?	YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>	BY WHOM	DATE STARTED	DATE COMPLETED	TIME SPENT
B. ACCOUNT CHARGED — TIME	ACCOUNT CHARGED — MATERIAL			PRESENT LOCATION OF DEVICE	
C. PRESENT LOCATION OF DOCUMENTS (DATE SIGNED AND WITNESSED), INCLUDING PHOTOS, DRAWINGS, AND DATA SHEETS SHOWING REDUCTION TO PRACTICE				Bldg 250, Room # 2046	

NOTE: ALL EVIDENCE OF CONCEPTION (FIRST DRAWING AND FIRST WRITTEN DESCRIPTION) AND EVIDENCE OF REDUCTION TO PRACTICE (DEVICE EMBODYING THE INVENTION AND TEST DATA) MUST BE RETAINED.

5. RELATION TO GOVERNMENT CONTRACT

A. DOES THIS INVENTION RELATED TO WORK PERFORMED UNDER A GOVERNMENT CONTRACT?	YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>	CONTRACT NUMBER AND TITLE
B. IS INVENTION BEING USED ON A GOVERNMENT CONTRACT?	YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>	CONTRACT NUMBER AND TITLE

6. RELATED DOCUMENTS AND DISCLOSURE (BY YOU OR BY ANOTHER). PLEASE ATTACH COPY.

A. IS THERE A PUBLICATION OR PUBLIC PRESENTATION RELATED TO THE INVENTION?	YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>	DATE	IDENTIFY
B. ARE THERE ANY RELATED INVENTION DISCLOSURES OR PATENT APPLICATIONS?	YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>	DATE 2/12/2000	IDENTIFY PD NO. ETC. HRL PD # 000210
C. ARE THERE ANY PROPOSALS OR REPORTS OR OTHER DOCUMENTS RELATING TO THIS INVENTION	YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>	DATE	IDENTIFY Add on new task to our present NGI program proposal to DARPA
D. HAS THE INVENTION BEEN USED, DISCUSSED, DEMONSTRATED OR OTHERWISE DISCLOSED OUTSIDE THE COMPANY (SUCH AS TO A VENDOR OR CUSTOMER)?	YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>	DATE	TO / FOR WHOM (COMPANY / PERSON)

7. SALE

A. HAS PRODUCT EMBODYING INVENTION OR MADE BY INVENTION BEEN PROPOSED, SOLD, OR OFFERED FOR SALE?	YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>	ORDER NO.	ORDER DATE	DELIVERY DATE	DATE OFFERED OR PROPOSED
B. IS PRODUCT EMBODYING INVENTION OR MADE BY INVENTION IN A DELIVERABLE ITEM?	YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>	DELIVERY DATE			

HUGHES PROPRIETARY

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION, AND EXCEPT WITH WRITTEN PERMISSION OF HUGHES AIRCRAFT COMPANY, SUCH INFORMATION SHALL NOT BE PUBLISHED, OR DISCLOSED TO OTHERS, OR USED FOR ANY PURPOSE, AND THE DOCUMENT SHALL NOT BE DUPLICATED IN WHOLE OR IN PART. THIS LEGEND SHALL BE APPLIED TO ALL DOCUMENTS CONTAINING THIS INFORMATION.

H. Izadpanah
SIGNATURE INVENTOR

Greg Tangonan
SIGNATURE INVENTOR

8/17/00
DATE

8/12/00
DATE

PATENT DOCUMENT NO.
LABORATORIES

AUG 21 2000

PD# 000805

INVENTION DISCLOSURE

THIS INVENTION DISCLOSURE IS MADE
PURSUANT TO MY / OUR INVENTION AGREEMENT
WITH HUGHES AIRCRAFT COMPANY.

8. SUMMARY OF THE INVENTION

- A. GIVE A BRIEF DESCRIPTION OF YOUR INVENTION, PARTICULARLY POINTING OUT WHAT IS BELIEVED TO BE NOVEL (THE "HEART" OF WHAT IS NEW).

The invention proposes a terrestrial hybrid "all-weather" (rain, fog, and snow) RF/optical wireless communication links and network architecture suitable for wireless access, distribution, and backbone network inter-connections. The hybrid solution provides enhanced wireless network reliability and an increased network aggregate capacity under all-weather and diverse atmospheric conditions. Other new capability and advantages are higher channel rates compared to RF link alone, higher wireless network availability, link fail/safe operation/path protection, selective traffic routing, and more importantly a relatively high "secure" link.

- B. EXPLAIN THE PURPOSE AND ADVANTAGES OF YOUR INVENTION. (WHAT WILL THE INVENTION DO BETTER THAN DONE PREVIOUSLY?)

The followings are the purpose of invention:

- Provide wireless solutions for an "all-weather" link operation and availability
- Increase and complement the otherwise limited speed RF and mm-wave wireless links for Gbit data transfer capabilities
- Bring the fiber optic bandwidth and networking capabilities closer to the end user, mix and match the wireless link to the fiber network, and
- Enhance the end-to-end network functionality (diverse routing, path protection, service segregation, etc.) by the hybrid approach.

- C. IDENTIFY THE COMPANY PROGRAM OR PRODUCT LINE TO WHICH THE INVENTION APPLIES, AND THE EXPECTED VALUE TO THE PROGRAM OR PRODUCT LINE. ALSO IDENTIFY POTENTIAL COMMERCIAL APPLICATION OF THIS INVENTION, INCLUDING AUTOMOTIVE APPLICATIONS, IF ANY.

There are two major owners programs which can benefit from this invention and gain additional part of RF/OW market:


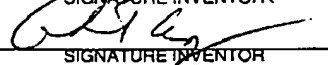
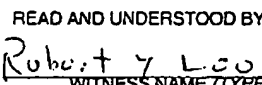

1. HSC/HNS - They already have programs and commercial products in mm-wave broadband wireless links and backbone fiber optic connections which can be complemented by this invention disclosure.
2. Raytheon with programs and applications in broadband mm-wave and laser communication systems plans to interconnect the Satellite laser feeder and terrestrial broadband LMDS RF channels.

- D. IDENTIFY THE PRIOR ART KNOWN TO YOU WHICH IS IMPROVED UPON OR DISPLACED BY YOUR INVENTION, AND STATE IN DETAIL, IF KNOWN, THE DISADVANTAGES OF THE CLOSEST PRIOR ART.

The prior art is the RF/mm-wave wireless links highly affected by the atmospheric propagation and limitation in channel speed and available spectrum. The field of system application for terrestrial optical wireless is very new and, in conjunction with the existing mm-wave broadband systems, can create many new networking capabilities and potential applications. The hybrid approach to wireless links can increase the network throughput (the maximum mm-wave channel speed today is 155 Mbps with aggregate link capacity hardly approaching Gbps), reduce the system cost (expensive indoor/outdoor RF units), and remove the critical RF system design complexity. Other disadvantages of RF system are the spectrum availability and licensing and its nature of "analog" signal format where as the optical link can accommodate, simultaneously, signals with digital, analog, sub-carrier modulation, etc formats. Finally, the license-free optical link has much higher degree of link "security" for interception relative to the RF link.

HUGHES PROPRIETARY

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION, AND EXCEPT WITH WRITTEN PERMISSION OF HUGHES AIRCRAFT COMPANY, SUCH INFORMATION SHALL NOT BE PUBLISHED, OR DISCLOSED TO OTHERS, OR USED FOR ANY PURPOSE, AND THE DOCUMENT SHALL NOT BE DUPLICATED IN WHOLE OR IN PART. THIS LEGEND SHALL BE APPLIED TO ALL DOCUMENTS CONTAINING THIS INFORMATION.

		8/17/2000
SIGNATURE INVENTOR		DATE
		8/17/00
SIGNATURE INVENTOR		DATE
READ AND UNDERSTOOD BY:		
		8/17/00
WITNESS NAME (TYPE)	SIGNATURE	DATE
WITNESS NAME (TYPE)	SIGNATURE	DATE

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SHEET 4 OF

9. DETAILED DESCRIPTION

DESCRIBE YOUR INVENTION IN DETAIL, USING NECESSARY ADDITIONAL SHEETS

- A. BE SURE THAT EACH SHEET IS DATED, AND SIGNED BY EACH INVENTOR AND TWO WITNESSES.
(HAC FORM 236C-6 CS SHOULD BE USED, IF PRACTICAL).
- B. ATTACH COPIES OF DRAWINGS OR DETAILED REPORTS HELPFUL IN UNDERSTANDING HOW YOUR INVENTION WORKS
- C. IF YOUR INVENTION HAS BEEN TESTED, BRIEFLY SUMMARIZED THE TEST RESULTS WHICH CONFIRM THE FUNCTIONS AND ADVANTAGES LISTED IN 8 B ABOVE.

Gigabit data transport and processing technologies are required to respond to the present and future information distribution and high-speed Internet application needs. Fiber optics technology has already matured for Terabit data transport. However, for places lacking the fiber cables, wireless (RF and/or optical) is the medium of choice for access and distribution. But, in the wireless domain (specially the RF), the maximum communication channel speed, data rates, link performance and availability are limited by propagation effects, atmospheric degradation, and environmental factors. Typical bit rate, for a RF system, is in the lower Mbps range for mobile, and a few hundred Mbps for fixed wireless links. In addition, even at these low data rates the link performance quality and error performances are many order of magnitudes below that of fiber optics. To overcome these limitations and bring the fiber optics bandwidth utilization closer to the end user, we propose the adaptation of a hybrid RF and Free-Space Optical Wireless (FSOW) link solution for wireless access and backbone network connections. We suggest several new network architectures for different applications using the combined and complementary aspects of the hybrid link.

The invention focus is on the multi-purpose "all-weather" existing fiber network extension into the wireless domain. The proposed topology ensures higher degree of the wireless link availability when the mm-wave fails during the rain or the FSOW power budget falls below the threshold during the foggy weather. The combined FSOW and mm-wave links then provide:

- High-speed wireless network availability in all-weather and diverse atmospheric conditions for fail/safe operation and path protection
- Complementary wireless links for flexible/adjustable operating bandwidth and network throughput at low/high utilization periods. Multi-Gbit bandwidth allocation is possible in clear weather and gracefully be decreased as the weather conditions become hostile to each or both links but the link can be maintained all the time.
- Flexibility of selective traffic routing to alternate end-users for geography diversity, multi-service and multi-cast/broadcast operation, and more importantly
- An optical "secure" link and channel for sensitive traffics

Network Architecture:

1. "All-weather" hybrid links - Here, we propose to implement a side-by-side point-to-point FSOW link with an RF/mm-wave wireless link as shown in Fig. (1). The links are connected to the network gateway (GW) via a path selector switch (SW) to operate for active/standby link selection. Compared to the RF wireless link alone, the link topology then provides the following network functionality:

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- A redundant standby link for fail/safe operation based on alternate switched-path criteria and route diversity options. The network performance monitoring is a well known in the art and a decision algorithm and circuit is implemented based on the network performance data and a pre-set threshold to determine the switch position.
 - When the weather permits (e.g. clear weather), the addition of the laser link (LaserCom) provides a high-speed connection in multi-Gbit regime and beyond of the capability of the RF wireless link.
 - The hybrid link can be configured for an "Asymmetric" communication channel with LaserCom Gbit speed say for downstream (which RF may not be capable of) and lower speed RF link for upstream.
 - The combined hybrid link is also highly suitable for aggregate capacity and bandwidth allocation management to cope with required traffic volume and/or the atmosphere conditions. In response to the traffic volume, a flexible varied aggregate capacity can be obtained from the hybrid link in either direction which, for the RF link alone, may not be possible. This is an important network flexibility in a varied weather condition without the loss of connection. Example is to start 2.5 Gbps LaserCom with 622 Mbps RF link. When the weather starts to degrade the signal (rain for the RF and fog for the Laser) in either link, the speed is lowered to maintain the link QoS. communication link aggregate capacity.
2. Multi-Channel, Multi-Band "All-weather" Hybrid Links: The functional capability of the hybrid link mentioned in part [1] above can easily be extended to multi-channel communication system as well. The RF channels operating in multiple bands (Cellular, PCS, NII, mm-Wave, etc.) have their conventional transmit/receive hardware and link setup as shown in Figure (2). A single LaserCom added link will provide the all-weather network functionality similar to what was mentioned for the single channel above. However, the optical signal will carry a multiple Sub-Carrier Modulated-SCM (digital and/or analog) channels pairing with their RF counterparts. The SCM techniques are well known in the art and fiber optic components and technology is available for RF carriers well above the presently operating mm-wave wireless bands.
3. Complementary Wireless Link Architecture: Figure 3 shows a "serial" complementary link based on hybrid concept. In this scenario, a FSOW link provides high-speed and Gbit capacity transport link to a remote region where "all-RF" transmission (high rates or other limitations) is not possible. However, the local and regional point-to-multi point distribution is achieved by the RF wireless links. The scheme is similar to HFC and HFR architecture but in the wireless domain. Examples include (PCS, MMDS, LMDS distribution technology. An important advantage of this "total" wireless solution is that the RF distribution cell diameters can be reduced to a few meters (tens and hundred) for a low power high-speed wireless operation [Ref. 1-2]. This is the technique by which the fiber optic bandwidth and capability is brought closer to the end-user and pushed deeper in the network. The figure shows examples of point-to-multi point low power distribution for a single building as well as for a small regional users.
4. Here, we also propose to apply the technique and architecture described in part [4] above to multi-band hybrid wireless applications. A possible architecture is shown in Fig. (4) where the Multi-band RF point-to-multi point distribution is connected to the backbone network by a single LaserCom link accommodating the channels in the for of SCM, TDM, WDM, or any of these combinations.
5. We also propose to provide a similar service and network architecture described in parts [1 to 4] to a region or building located in the shadow of antenna(s) of the backbone network. The link closure is achieved by

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employing an optical "reflector/relay" device where the laser beam is deflected and focused to the otherwise obscured receiver as shown in Fig. (5).

6. Finally, as shown in Figure 6, we propose to adopt and apply the above techniques and architecture to all weather survivable SONET rings topology carrying single or multiple wavelength (WDM) for:
- Protective wireless ring closure
 - Protective RF distribution channels
 - Increased RF one/multi-band channel speed and aggregate capacity by utilizing SCM and WDM described above.

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RF & Optical Hybrid Wireless Network Architectures For Heterogeneous Network Integration

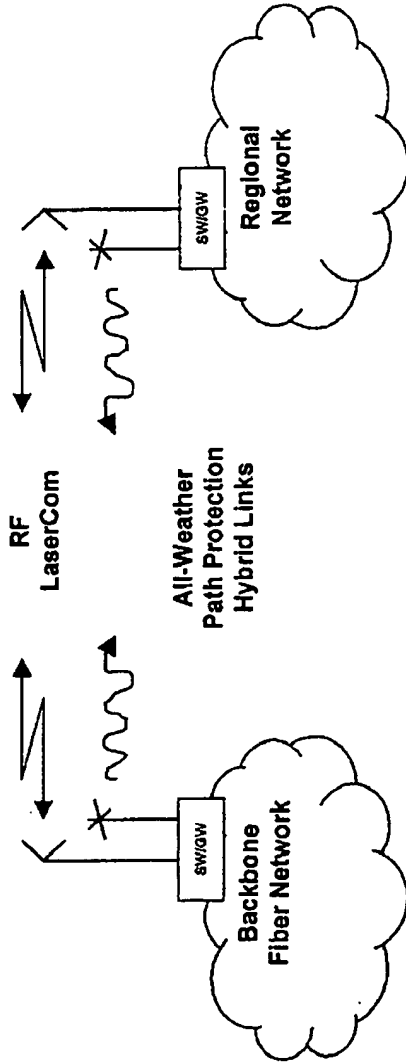
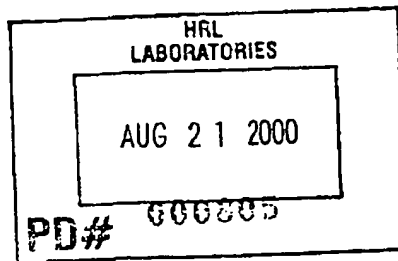


Fig. (1)



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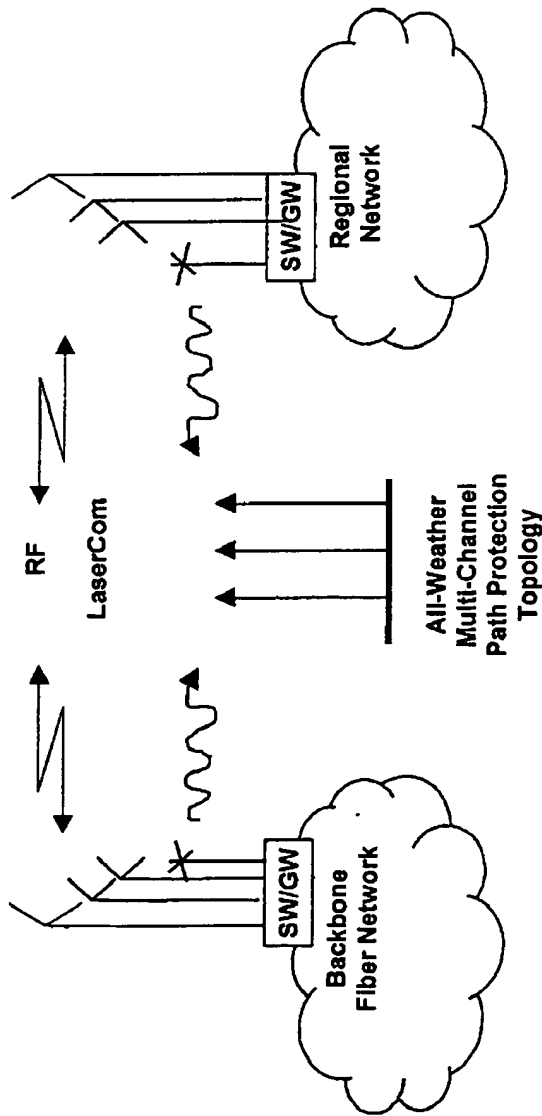


Fig. (2)

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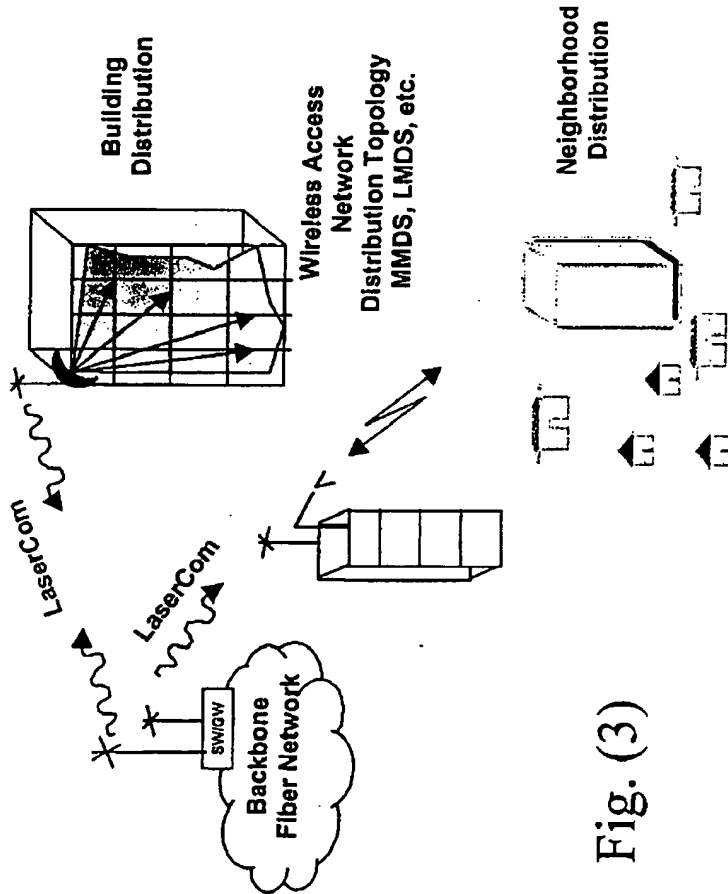


Fig. (3)

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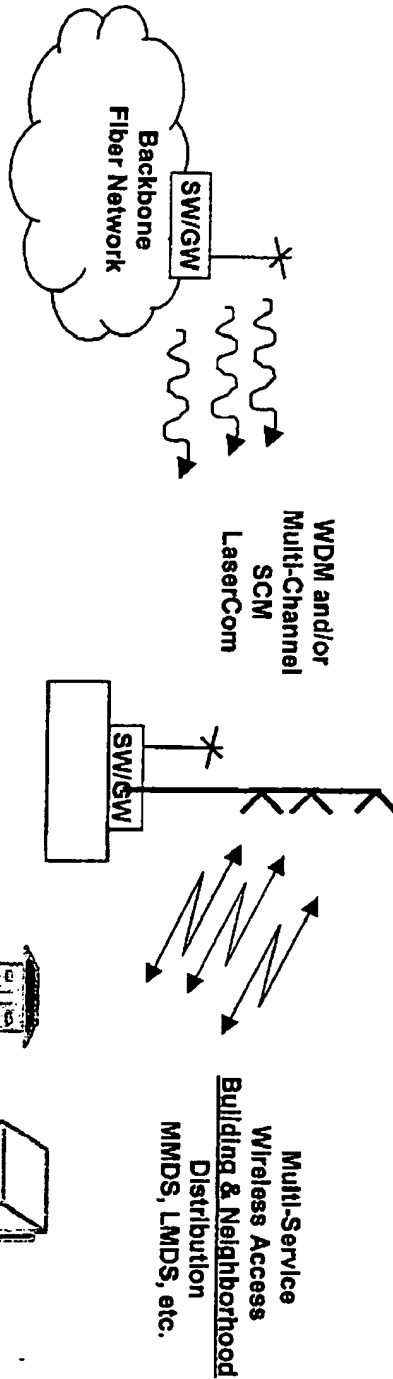


Fig. (4)

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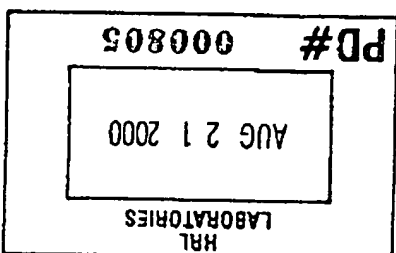
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**All Whether Hybrid mm-Wave/LaserCom Protective WDM Network
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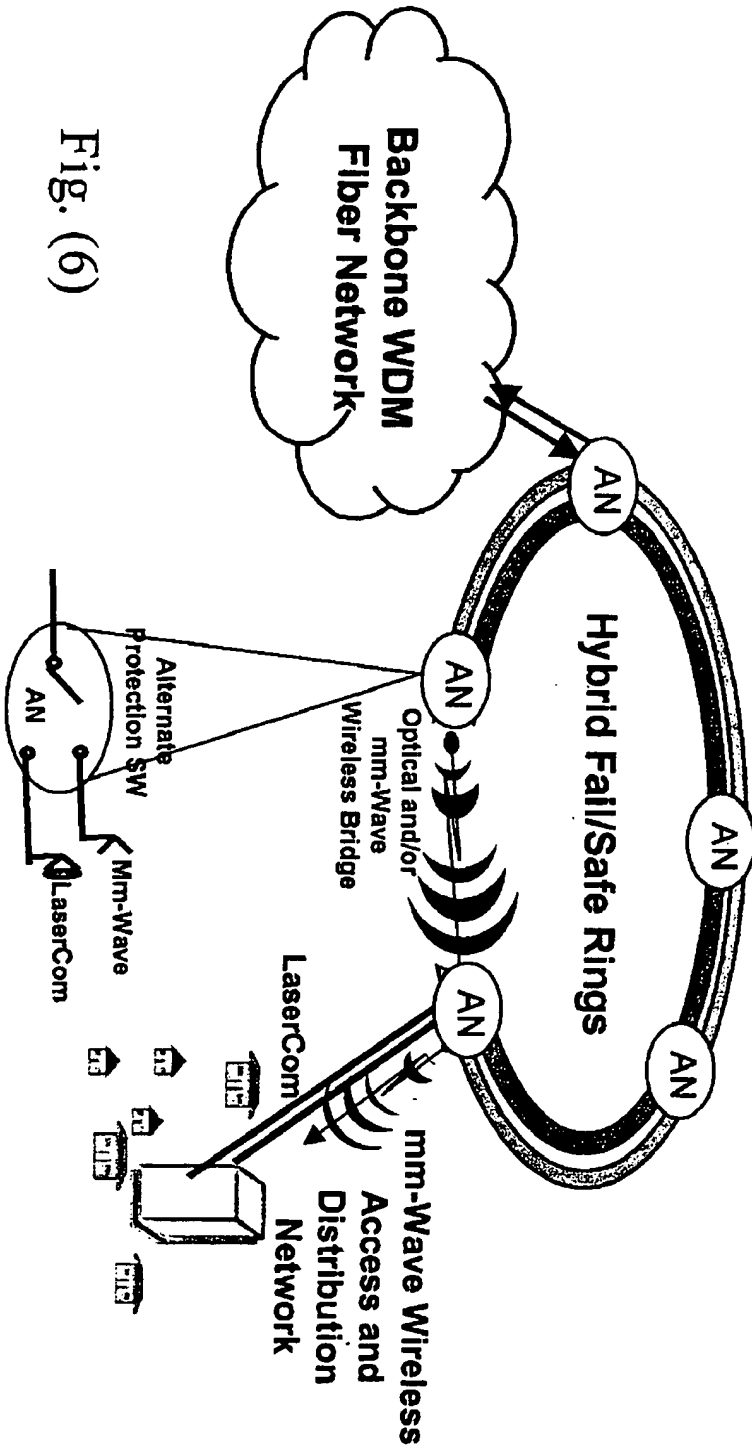


Fig. (6)

Combined Fiber/Free-Space/RF/mm-Wave Heterogeneous Network Topology
Complementary, Switched Fail/Safe, and Redundant Protective Links

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